CLAIMS

1. A measuring apparatus for determining data relating to the shape of an input radiation wavefront, the wavefront shape being describable at a pre-determined location in an optical system:
the apparatus comprising aberration means, the shape of which is defined by a filter function;
detection means having a radiation sensitive surface capable of detecting the intensity of incident radiation on the surface, the detection means being coupled to an output device that provides a measure of the intensity of the incident radiation;
wherein the aberration means acts on any input wavefront shape to produce first and second output radiation signals that in combination provide data from the output device on the extent to which the wavefront shape is non-planar.

2. A measuring apparatus as claimed in Claim 1 wherein the aberrating means creates at least two filter functions, the filter function being complex conjugate pairs.

3. A measuring apparatus as claimed in Claim 1 or Claim 2 wherein, the filter function is complex valued and has non-mixed symmetry.

4. A measuring apparatus as claimed in Claim 1 or Claim 2 further including a wavefront modulator.

5. A measuring apparatus as claimed in Claim 4 wherein the wavefront modulator is configured to transform a wavefront being describable by means of a complex function into a wavefront being describable by a real function.

6. A measuring apparatus as claimed in any preceding Claim wherein the output device is provided with calculation means for calculating the difference between the first and second radiation signals.

7. A measuring apparatus as claimed in any preceding Claim wherein the radiation sensitive surface of the detection means is provided with elements that allow

the measurement of radiation intensity at different points across the surface of the detection means.

8. A measuring apparatus as claimed in Claim 6 wherein the output device is provided with calculation means for calculating the difference between the first and second radiation signals at different points across the surface of the detection means

9. A measuring apparatus as claimed in any of claims 4 to 8 wherein the wavefront modulator is coupled to the output device such that the wavefront modulator is distorted to provide a correction to a non-planar input radiation wavefront.

10. A measuring apparatus as claimed in any preceding Claim wherein the aberration function is a weighted sum of Zernike polynomials arranged to equalise the signal generated from each mode of deformation in the input wavefront according to the expected statistical distribution of such modes in the input wavefront.

11. A measuring apparatus as claimed in any preceding Claim wherein the aberration means is arranged such that the complex conjugate aberration functions of the aberration means are associated with diffraction orders of the same order but having different sign.

12. A measuring apparatus as claimed in any preceding Claim wherein the first and second output radiation are produced simultaneously.

13. A measuring apparatus as claimed in any of Claims 1 to 12 wherein the first and second output radiation are produced sequentially.

14. A measuring apparatus as claimed in any of claims 1 to 12, wherein the aberration means is a diffractive optical element.

15. A measuring apparatus as claimed in any of claims 1 to 12, wherein, the aberration means can be a variable-shape optical mirror

16. A measuring apparatus as claimed in any of claims 1 to 12, wherein the aberration means is a variable refractive index device.

17. A measuring apparatus as claimed in claim 16 wherein the variable refractive index device is a liquid crystal phase modulator used sequentially to provide complex conjugate aberrations.

18. A measuring apparatus as claimed in any of claims 1 to 12, wherein, the aberration means is a deformed reflective surface where the illumination of that surface from each side produces the complex conjugate aberration functions.

19 A method for determining data relating to the shape of an input radiation wavefront, the wavefront shape being describable at a pre-determined location in an optical system:
the method comprising the steps of
transmitting said input radiation wavefront through an aberration means, the shape of which is defined by a filter function
detecting the intensity of incident radiation on a surface,
sending the detected intensity to an output device that provides a measure of the intensity of the incident radiation;
wherein the aberration means acts on any input wavefront shape to produce first and second output radiation signals that in combination provide data from the output device on the extent to which the wavefront shape is non-planar.

20. A method as claimed in claim 19 wherein the filter function is complex valued and has non-mixed symmetry.

21. A diffractive optical element comprising aberration means, the shape of which is defined by a filter function that is complex valued and which has non-mixed symmetry.

22. A diffractive optical element as claimed in Claim 21, wherein, the aberration means can be a variable-shape optical mirror

23. A diffractive optical element as claimed in Claim 21, wherein the aberration means is a variable refractive index device.

24. A diffractive optical element as claimed in Claim 21wherein the variable refractive index device is a liquid crystal phase modulator used sequentially to provide complex conjugate aberrations.

25. A diffractive optical element as claimed in Claim 21, wherein, the aberration means is a deformed reflective surface where the illumination of that surface from each side produces the complex conjugate aberration functions.

26. A method for creating a diffractive optical element comprising the steps of defining aberration means the shape of which is defined by a filter function and which has non-mixed symmetry, applying said filter function to an optical element to create a diffractive optical element.